

## REMOVAL BY CAFFEIN OF SOME DIGITALIS ARRHYTHMIAS: ILLUSTRATED BY TRACINGS.

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WHEN digitalis is administered in cases of heart failure in which the auricles are fibrillating the gross irregularity of the ventricle observed in this condition is not materially lessened, although, as is well known, the rate of the heart beat is greatly slowed and the subjective symptoms are often magically ameliorated.

In cases of heart failure in which the rhythm is normal, digitalis slows the pulse only moderately, and what is of considerable interest, tends often to induce irregularities of several different kinds, chief of which are premature contraction and heart block. I have observed in several instances of marked heart failure after prolonged use of digitalis the appearance of dicrotism, and when this dicrotism is unaccompanied by pulsus alternans it is removed by caffein.

Premature contractions produced by digitalis are fairly common, and are usually of ventricular origin. Partial heart block following digitalis is also very common. In some cases of digitalis block the *As-Vs* interval is found widened previously to or concomitantly with the block, while in other cases this phenomenon is not observed. Partial heart block and premature contractions following digitalis are often associated.

Digitalis heart block has been attributed by some to reduction of conductivity of the auriculoventricular bundle, by others to increase of vagus inhibition. In favor of the latter hypothesis is the fact that the block can be partly removed by atropin; in favor of the former view is the fact that in auricular fibrillation digitalis slows the heart chiefly by depressing the conductivity of the bundle. As a matter of fact, both factors may be involved, and in the present state of our knowledge we cannot define absolutely their relative values.

Digitalis is known to slow the heart rate while caffein accelerates it. If the slowing by digitalis is partly produced by lowering the irritability of the conduction system the effect of caffein in accelerating the rate is partly due to an opposite effect. Caffein tends to raise the irritability of the conducting system. It should therefore theoretically neutralize or possibly overcome the effects of digitalis upon the heart. My investigations have tended to show that the cardiac effects of digitalis, particularly in respect to interference with conduction, are quickly overcome by caffein. For some time past in the hospital wards I have observed the effects of caffein in cases which showed digitalis arrhythmias, and the following seven cases

briefly reported are selected from a considerable number to show that the theoretical considerations above mentioned are borne out by the facts.

Digitalis irregularities will usually cease spontaneously if the drug is stopped, but sometimes instances arise in which, unfortunately, the drug has been prolonged in its administration until the toxic effects upon the conducting system are only too manifest, and in these the administration of caffein will do good.

The first two cases show pulsus bigeminus, due to extreme dirotism under circumstances of great enfeeblement of contractility. The second case shows marked pulsus alternans. This case died suddenly at the time when the experiment of administering caffein was about to be tried, and the tracing is shown because it is similar to Case I with respect to dirotism; but there is one important difference, and that is that in Case II pulsus alternans is present, which is, under all circumstances, of extremely grave augury. In Case I the arrhythmia disappeared as soon as caffein was given.

Two cases are given in which block arose as a result of digitalis administration and one of spontaneous block. In all, the phenomenon of block was readily removed by caffein, as the tracings show.

I have seen block removed by caffein at times even while digitalis was being taken. It would appear that partial heart block or premature contraction is the rule rather than the exception when digitalis is kept up even in moderate doses for a long period of time in cases of heart failure with normal rhythm, and it is my experience that these disturbances of rhythm can be quickly removed by caffein.

One case of auricular fibrillation is given to show that caffein has no effect upon the irregularity itself any more than has digitalis, but nevertheless the rate increases under caffein even during digitalis administration, which tends to show, I believe, that the conductivity of the bundle of His lowered by digitalis is increased by caffein.

CASE I.—*Dicrotic pulsus bigeminus occurring in a case of heart failure; normal rhythm; prolonged digitalis administration; recovery.*

C. B. entered hospital November 12. From date of admission, November 12, to January 12, a period of two months, the patient ingested 7 grams of powdered digitalis and 3 ounces of the tincture. On January 7 a tracing was taken (*a b*) which showed marked dirotism.

January 13 digitalis was stopped and caffein sodium citrate, grs. iij, t. i. d, substituted.

January 18 a tracing of the radial pulse showed an almost complete disappearance of dirotism (*v c*). Concomitantly with this there was an improvement in the patient's condition.

January 31 strips of radial pulse tracings taken on this day showed a complete absence of dirotism (*v d e*). The pulse was regular and beating 72 to 80 per minute. Patient left the hospital apparently cured.

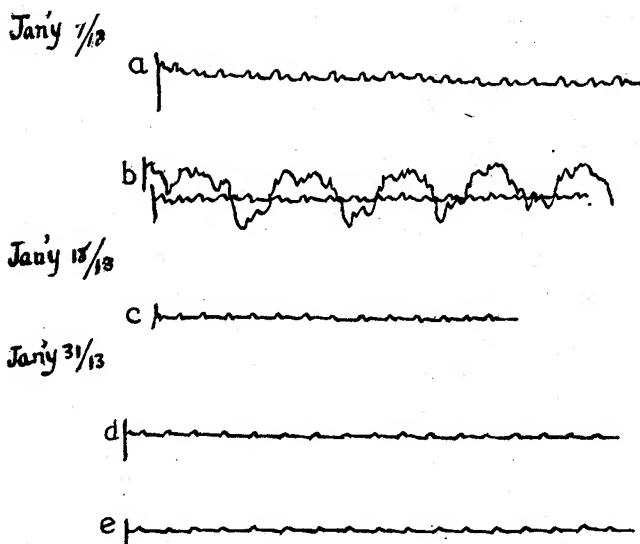


FIG. 1.—Case I, C. B.

CASE II.—*Dicrotic pulsus bigeminus with pulsus alternans; extreme heart failure; rapid but normal rhythm; prolonged digitalis administration; sudden death.*

J. H. entered hospital January 13. Between admission to hospital and February 5 he received 49 ounces of tincture of digitalis. On February 6 he was given powdered digitalis, and up to February 22 he took  $8\frac{1}{2}$  grams.

Feb. 20

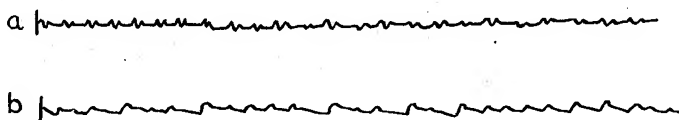


FIG. 2.—Case II, J. H.

On February 20 radial pulse tracings were taken. It was impossible to obtain jugular tracings on account of extreme respiratory distress. The radial pulse was dicrotic and showed pulsus alternans (*v a b*). He died suddenly during the night of February 22.

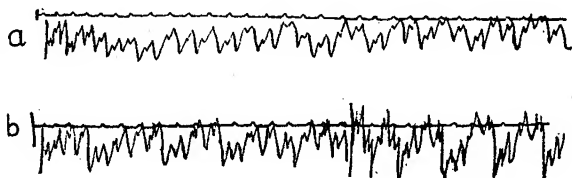
CASE III.—*Heart failure with normal rhythm; partial heart block and pulsus bigeminus removed by caffein; exitus.*

H. S. entered hospital September 6. September 27 a pulse tracing showed feeble rapid pulsations but normal rhythm. Jugular tracing shows absence of *v* waves (*v a b*). From the date of admission, September 6, until January 19, a period of 135 days, the patient took in all 10 grains of strychnin, 540 grains of caffein citrate, and 33 ounces (one quart) of infusion of digitalis. On

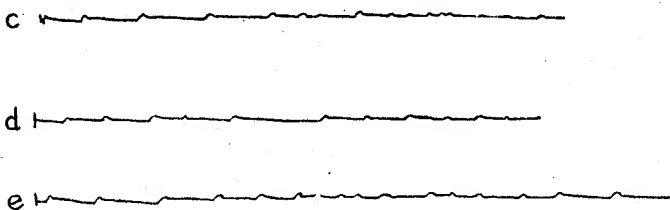
January 20 a tracing of the radial pulse showed partial heart block with occasional slight tendency to dicrotism and bigeminism (*v c d e*). Digitalis was stopped on January 21 and caffein sodium benzoate grs. iij, opium gr. ss, and calomel gr. ss, t. i. d., substituted.

January 27 the polygraphic record showed complete disappearance of the block.

Sept. 27, 1912



Jan. 20, 1913



Feb. 15, 1913

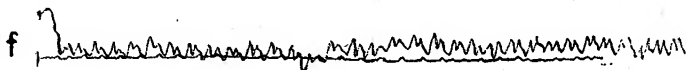


FIG. 3.—Case III, H. S.

A tracing taken on February 15 showed no block. The radial pulse was extremely small and showed a trace of dicrotism (*v f*). For five days preceding February 15 digitalis had been again given,  $\text{M}_{\text{XV}}$ , t. i. d. The patient died soon afterward and autopsy showed a much dilated heart, with extremely thin, flabby musculature and wide, patulous mitral orifice.

CASE IV.—*Auricular fibrillation; digitalis slowed the pulse but did not abolish the irregularity; the rhythm was unaffected by caffein.*

This case, which was entirely similar to others observed in this regard, demonstrates that caffein is apparently without effect upon the rhythm of auricular fibrillation.

Kate G., aged sixty years, entered hospital on January 21. A tracing taken on January 23 showed the auricles were fibrillating. The pulse was rapid and extremely irregular, and there was a total absence of *a* wave in the jugular tracing (*v a*). The patient was put on tr. digitalis,  $\text{M}_{\text{X}}$ , t. i. d., for a week.

January 27. A strip of radial tracing showed no change (*v b*).

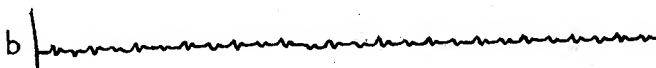
January 30. Tracings taken and conditions found unchanged (*v c*).

February 6. Tracing taken and the conditions the same (*v d*). Caffein sodium citrate began, gr. iij, t. i. d., on February 7 and continued until February 19. No change was noted.

Jan'y 23



Jan'y 27



Jan'y 30



Feb 6



Mch 6



FIG. 4.—Case IV, K. G.

March 6. Tracing taken. Result unchanged (*v e*). Patient was put back upon digitalis February 19, one dose per day of 10 minims, which was found sufficient to keep the heart slowed and ameliorate the subjective symptoms. Patient was discharged about the middle of March.

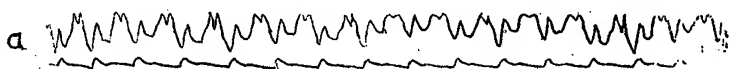
CASE V.—*Heart failure accompanying mitral insufficiency with a secondary tricuspid regurgitation; normal rhythm; premature contractions and partial heart block produced by digitalis; removal by caffein.*

J. J. entered hospital January 25. Tracings were taken January 27 and showed practically normal rhythm (*v a*). The patient was put on tincture of digitalis, ℥xv, t. i. d. Nine days later, February 6, tracings were taken, all of which showed premature contractions and partial block.

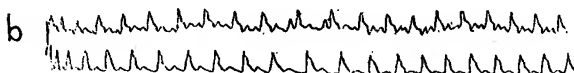
February 6. Digitalis was discontinued and caffein sodium citrate, grs. iij, t. i. d., substituted (*v b c d*).

February 10. Strips of radial pulse tracing were taken and showed complete disappearance of the arrhythmia (*vef*).

Jan. 27



Feb. 6



Feb. 10

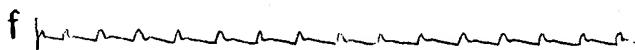
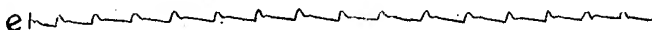
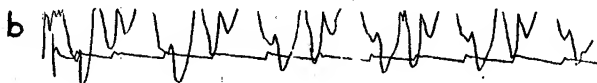
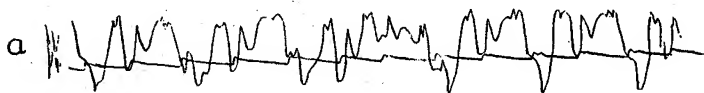


FIG. 5.—Case V, J. J.

Feb. 10



Feb. 12



FIG. 6.—Case VI, Mrs. D.

CASE VI.—*Partial heart block of sino-auricular type produced by digitalis in a case of moderate heart failure in a pregnant woman; normal rhythm; removal of block by caffein.*

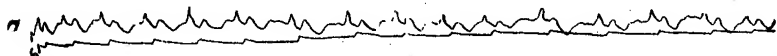
Mrs. D. entered hospital in March. She was near term and suffering from symptoms of heart failure accompanying mitral regurgitation. The cardiac rhythm was normal. The patient was given tincture of digitalis,  $\mathfrak{M}\text{x}$ , t. i. d., and kept upon it for some time.

Tracings taken February 10 showed partial heart block (*v a b*). Digitalis was immediately stopped and caffein sodium citrate, grs.  $\text{ijj}$ , t. i. d., substituted. Two days later tracings showed complete absence of the arrhythmia (*v c d*).

CASE VII.—*Spontaneous heart block with pulse rate of about 46 to 48; caffein diminished the block and raised the pulse frequency to 74 to 76.*

Admitted to hospital March 14. Patient was an elderly man. Tracings taken March 18 showed 2 to 1 heart block (*v a*). He was

March 18, radial pulse 46



March 23, radial pulse 74

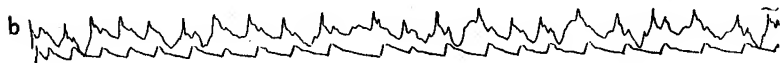


FIG. 7.—Case VII, G. W. T.

given caffein sodium citrate, gr.  $\text{v}$ , t. i. d. A tracing taken five days later, March 23, showed almost complete disappearance of the block. Pulse increased to 74 (*v b*).

CASE VIII.—*Spontaneous heart block.*

CONCLUSION. All the irregularities of the heart beat which are brought about by digitalis tend to be removed by caffein. Although in many cases digitalis arrhythmia will spontaneously disappear when the drug is stopped, instances arise, unfortunately too common, in which after prolonged digitalis administration the conductive system is so depressed that serious results may arise. Under these circumstances the administration of caffein will be of service and therefore strongly indicated. The action appears to be due to the increase in irritability of the conduction system produced by the caffein, which antagonizes and finally overcomes the depressing effects which digitalis exerts upon the auriculo-ventricular bundle.